

posits of Upper Cretaceous age were removed. The existing patches of the Tuscaloosa and Eutaw in this region represent remnants of these formations which were probably continuous at one time over most or all of the present western Highland Rim.

BOTANY.—*A new species of Dracaena from the Department of Petén, Guatemala.*¹ C. L. LUNDELL, University of Michigan. (Communicated by H. H. BARTLETT.)

While collecting in the savanna country of the Department of Petén, Guatemala, in 1933, I discovered a grove of very interesting monocotyledonous trees in Monte Hiltun, a strip of forest separating Sabana Hiltun and Sabana Zotz. The trees were not in flower or fruit so that only sterile material was obtained. The species is apparently referable to the genus *Dracaena*.

Dracaena petenensis, sp. nov.

Arbor solida 6 usque ad 12 m. alta. Caulis 20–30 cm., basi expansa 70–90 cm., diam. Cortex tenuis fissuris irregularibus aliquantulum angustatisque et fastigiis paucis, inaequalibus, acutis, humilibus, griseus fusco-maculatus sub folia circulis griseis, fuscis vel rubris irregulariter circumdatus. Rami pauci, crassi, 15 cm. sub apice 10–15 mm. diam. Folia ramorum apice congesta, pendula, minutissime, serrulata glabri, griseo-viridia, 115–140 cm. longa, 18–20 mm. lata, basta dilata, amplexicaulia, integra scariosa, laminis linearibus, supra basin angustatis apice in aciem late setiformem coarctatis.

Type in the herbarium of the University of Michigan, *C. L. Lundell 3271*, collected in Monte Hiltun, Department of Petén, Guatemala, May 17, 1933. Cotype deposited in the United States National Herbarium, Washington, D. C.

The characters which distinguish *Dracaena petenensis* are (1) the massive trunk with expanded base, (2) the few, thick branches, and (3) the crowded, pendent, minutely serrulate, linear leaves 115 to 140 cm. long and 18 to 20 mm. wide. The other New World representative of the genus, *Dracaena americana* Donn. Smith, is occasionally encountered in the same region. It is a smaller tree with entire leaves 20 to 30 cm. in length.

¹ Received February 7, 1935. Papers from the Department of Botany and the Herbarium of the University of Michigan, No. 527.

ZOOLOGY.—*The histology of nemic esophagi.* IV. *The esophagus of Metastrongylus elongatus.*¹ B. G. CHITWOOD, Bureau of Animal Industry and M. B. CHITWOOD.

This is the fourth paper of a series² dealing with the structure of the

¹ Received November 18, 1934.

² CHITWOOD, B. G., and CHITWOOD, M. B. *The histology of nemic esophagi.* I.

esophagi in various groups of nematodes. In this paper, insofar as possible, the same nomenclature for the various nuclei and cells will be used as in the previous papers.

GROSS MORPHOLOGY

The esophagus of *Metastrongylus elongatus* is clavate and may show grossly 3 indistinct regions, an anterior moderately narrow part or corpus, a very slightly narrower part, or isthmus, and a posterior wide part or bulbar region. The length of the esophagi in specimens studied varies from 262μ to 616μ ; however, in the description a single specimen with an esophagus 450μ long has been used, since relative positions and lengths are fairly constant. In this specimen the corpus is approximately 162μ long, the isthmus 90μ long, and the bulbar region 198μ long. The dorsal esophageal gland opens into the lumen at the anterior end of the esophagus, while the subventral glands open into the lumen 126μ from the anterior end or 36μ from the posterior end of the corpus. The lumen is triradiate throughout the length of the esophagus; in the anterior part of the corpus the ends of the radii are very slightly rounded (Fig. 1b) and the cuticle is thickened.

NUCLEAR DISTRIBUTION

The corpus may be subdivided into 2 regions, a precorpus and a postcorpus, on the basis of nuclear distribution, these regions approximating the parts of the corpus of *Rhabditis*.

Precorpus. In the anterior part of the corpus, 22 nuclei, comprising 6 radials (r_{1-6}) and 16 nerve cells (n_{1-16}) have been constantly observed. In addition to these there are 4 questionable bodies (s_{1-4}), possibly nuclei of nerve cells, and 1 nerve cell nucleus (n_{8x}) which sometimes appears to be distinct and sometimes identical with n_8 . The radial nuclei (r_{1-6}) are arranged in a single group of 6, 1 nucleus on each side of each sector 9 to 18μ from the anterior end of the precorpus.

The nerve cell nucleus n_1 is situated slightly to the right of the medio-dorsal position, 7μ from the anterior end of the precorpus; n_{2-3} are situated near the center of the subventral sectors at the same level as n_1 ; n_{4-6} are situated about 15μ from the anterior end, near the center of each sector; n_7 is about 9μ from the anterior end of the precorpus and in the center of the dorsal sector, while n_{8-9} are near the same level as n_7 , 1 nucleus in the center of each subventral sector; n_{10} is immediately posterior to n_9 , while n_{8x} is immediately posterior to n_8 or possibly identical with n_8 ; n_{11-13} are approximately 38μ from the anterior end of the precorpus, 1 nucleus near

The esophagus of Rhabdias eustreptos (MacCallum, 1921). *Zeit. f. Zellf. u. Micro. Anat.* 22: 29-37. 1934.

Ibid. II. *The esophagus of Heterakis gallinae*. *Zeit. f. Zellf. u. Micro. Anat.* 22: 38-46. 1934.

Ibid. III. *The esophagus of Oesophogostomum dentatum*. *This JOURNAL* 24: 557-562. 1934.

the center of each sector; and, finally, n_{14-16} are about 45μ from the anterior end.

The bodies s_{1-4} are near the external surface of the esophagus, s_{1-2} being about 18μ from the anterior end of the precorpus, 1 nucleus near the center of each subventral sector, while s_{3-4} are about 26μ from the anterior end of the precorpus and arranged similar to s_{1-2} .

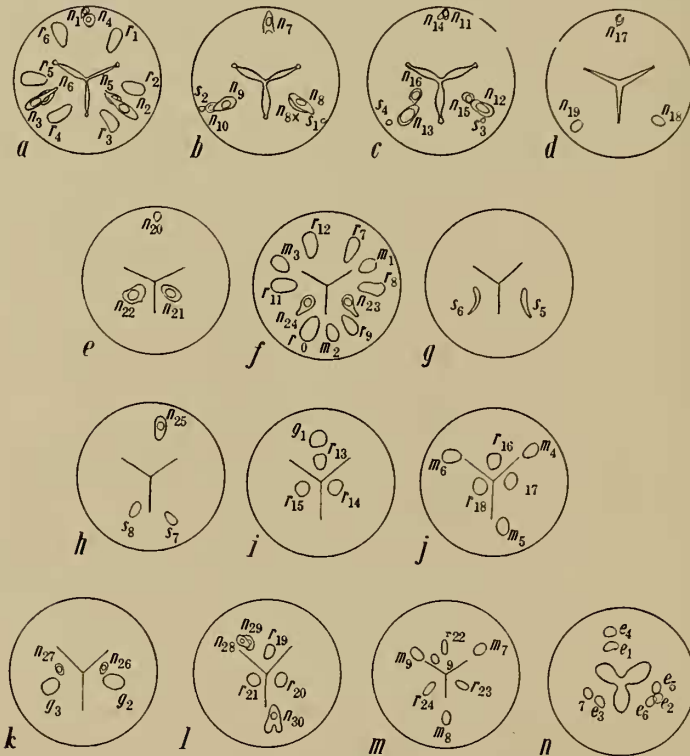


Fig. 1.—Nuclei of esophagus, diagrammatic representation. r , m , s , g , n , various types of nuclei; $a-c$, nuclei of precorpus; $d-h$, nuclei of postcorpus; $i-j$, nuclei of pre-valvar region; $k-m$, nuclei of postvalvar region; n , nuclei of esophago-intestinal valve.

Postcorpus. The postcorpus contains 22 nuclei comprising 6 radial nuclei (r_{7-12}), 3 marginal nuclei (m_{1-3}), 9 nerve cell nuclei (n_{17-25}), and 4 nuclei (s_{5-8}), possibly those of nerve cells. The marginal nuclei (m_{1-3}) are arranged as a group of 3, 1 nucleus at the end of each esophageal radius, about 72 to 80μ from the anterior end of the esophagus or about 18 to 26μ from the anterior end of the postcorpus. The radial nuclei (r_{7-12}) are arranged similar to the radials (r_{1-6}) of the precorpus and are about 6 to 12μ posterior to the marginal nuclei.

The nerve cell nuclei consist of 2 groups of 3 nuclei (n_{17-19} and $20-22$), 1 nucleus near the center of each sector, the first group situated approxi-

mately at the anterior end of the postcorpus, and the second group about 6 to 10μ posterior to the first group; a pair of subventral nerve cell nuclei (n_{23-24}) situated about 18 to 25μ from the anterior end of the postcorpus; and a single dorsal nerve cell nucleus (n_{25}) posterior to the orifices of the subventral glands, about 134μ from the anterior end of the corpus or 28μ from the posterior end of the corpus.

In addition to the above, there are 4 nuclei (s_{5-8}) which appear similar to those of nerve cells, but no cell body was observed. The first pair (s_{5-6}) is situated 6 to 10μ posterior to the radials r_{7-12} , 1 nucleus in each subventral sector, while the second pair (r_{7-8}) is near the posterior end of the postcorpus, about 6μ posterior to the last dorsal nerve cell (n_{25}).

Isthmus. As indicated by the distribution of nuclei, the isthmus is a region 90μ long between the corpus and the anterior part of the bulbar region, and contains no nuclei.

Prevalvar region. The anterior part of the bulbar region, the prevalvar region, contains 10 nuclei comprising 6 radial nuclei (r_{13-18}), 3 marginal nuclei (m_{4-6}), and 1 gland cell nucleus (g_1). The radial nuclei are arranged in 2 groups of 3 nuclei each, 1 nucleus of each group near the center of each sector; the first group (r_{13-15}) is about 6 to 12μ from the anterior end of the prevalvar region, while the second group (r_{16-18}) is situated 138 to 150μ from the anterior end of the region. The marginal nuclei (m_{4-6}) are arranged like those of the first group (m_{1-3}), and are situated at about the same level as the second group of radials (r_{16-18}) of this region.

The dorsal esophageal gland nucleus (g_1) is about half way between the 2 radial groups (r_{13-15} and $_{16-18}$) of this region. However, g_1 is quite variable in position, and in other specimens it may be situated further posterior, even at the level of the subventral gland nuclei.

Postvalvar region. The postvalvar region of the esophagus usually contains 16 nuclei as follows: 6 radials (r_{19-24}), 3 marginals (m_{7-9}), 2 gland cell nuclei (g_{2-3}), and 5 nerve cell nuclei (n_{26-30}). In addition to these, 1 more nucleus (s_9), possibly that of a nerve cell, has sometimes been observed. The radial nuclei are arranged in 2 groups of 3 nuclei each, 1 nucleus near the center of each sector; the first group (r_{19-21}) is situated 18 to 24μ from the anterior end of the postvalvar region, while the second group (r_{22-24}) is situated at the posterior end of the esophagus. The marginal nuclei (m_{7-9}) are arranged like the other margins (m_{1-3} and $_{4-6}$), and situated 6 to 10μ from the posterior end of the esophagus.

The subventral esophageal gland nuclei (g_{2-3}) are in the center of their respective sectors, at the anterior end of the postvalvar region in the particular specimen described here. Sometimes, these nuclei are situated in the prevalvar region, 6 to 10μ anterior to the last group of radials of that region (r_{16-18}).

The subventral nerve cell nuclei (n_{26-27}) are symmetrically placed, 1 nucleus near the center of each subventral sector, situated at approximately

the anterior end of the postvalvar region; the dorsal nerve cell nuclei (n_{28-29}) are situated just anterior to m_9 , with 1 nucleus (n_{28}) anterior to the other (n_{29}); the ventral nerve cell nucleus (n_{30}) is a little to the left of the ventral esophageal radius, 6 to 12μ anterior to m_8 . In addition to these nuclei, a right subdorsal nucleus (s_9) was observed in 1 series of sections; it appeared similar to the nucleus of a nerve cell but no cell body was observed.

Esophago-intestinal valve.—The esophago-intestinal valve consists of 2 parts, an anterior part with a trilobed lumen the wall of which contains 3 nuclei, 1 nucleus near the center of each lobe, and a posterior part with a rounded lumen the wall of which contains 4 nuclei, of which 1 nucleus is dorsal, 2 left subventral, and 1 right subventral.

CHARACTER OF NUCLEI

The radial nuclei each contain a moderate sized nucleolus lying in a finely granular, very delicately basophilic nucleoplasm. In cross section the radial nuclei of the corpus (r_{1-12}) are elongated, 7.9μ long by 3.7 to 4μ wide, their long axes corresponding to the radius of the esophagus; those of the pre-valvar region (r_{13-18}) are subtriangular, 6.2 to 7μ long by 5 to 5.8μ wide, while those of the postvalvar region (r_{19-24}) are ellipsoidal, 6.2 to 7μ long by 2.9 to 3.3μ wide.

The marginal nuclei are similar to the radial nuclei except that the nucleolus is slightly larger in proportion to the nucleus, and sometimes a second, smaller nucleolus is present. All of the marginal nuclei are ellipsoidal to slightly subtriangular. The nuclei of the first group (m_{1-3}) are about 3.4μ long by 3.3μ wide, those of the second group (m_{4-6}), 7.9μ long by 5μ wide, and those of the third group (m_{7-9}), 4.5μ long by 2.5μ wide.

The gland cell nuclei are the largest nuclei of the esophagus, the dorsal (g_1) 6.2μ long by 6.2μ wide, and the subventrals (g_{2-3}) 7μ long by 8.7μ wide. Each of these nuclei contains a proportionally large nucleolus in a very homogenous, basophilic nucleoplasm.

The nerve cells consist of several types, the nuclei varying greatly in size and character. A brief description of these nuclei may be clarified through reference to figure 4. The dorsal nerve cell nuclei of the corpus are of 3 types, as follows: n_1 is of a type containing a nucleolus in a nucleoplasm which shows no affinity for stain; $n_{4,7,17}$, and $_{25}$ are of a type containing a bilobed, irregular nucleolus, or 2 nucleoli in a nucleoplasm basophilic at the margin; $n_{11,14}$, and $_{20}$ are of a type containing a deeply basophilic nucleoplasm without distinct nucleolus. Of these, n_{25} appears to be a cell of the commissure at the base of the postcorpus, the cell body being large and the cytoplasm homogenous and eosinophilic; n_4 and $_7$ have similar cytoplasm or cell bodies, but are apparently bipolar; the remaining cells have a very small cell body and are spindle shaped and bipolar.

The subventral nerve cells of the corpus contain 2 types of nuclei, $n_{2-3,5-6,15-16,23-24}$ having a nucleoplasm basophilic at the margin, while $n_{8-9,10,12-13}$,

18-19, 21-22 contain a few basophilic granules but the nucleoplasm is not basophilic at the margin. All of the subventral nerve cell nuclei contain a bilobed nucleus or 2 separate nucleoli; the cells appear to be bipolar and the

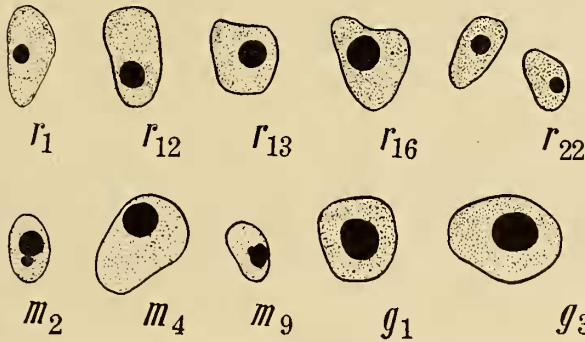


Fig. 2.—Individual nuclei of esophagus. Labelled as in fig. 1.



Fig. 3.—Nerve cells of esophagus. Labelled as in fig. 1.

cell bodies homogenous and basophilic, but the size and shape varies with the individuals cell (Fig. 4).

The bodies of the corpus labelled *s* are not all of the same character. Those labelled *s*₁₋₄, possibly nerve cells, are strongly basophilic and somewhat similar to *n*₁₁, but no cell bodies were observed (the writers are not entirely

certain that they are nuclei); s_{5-6} are obvious nuclei with lobed nucleoli and clear nucleoplasm, 1 body lying near the inner ventral side of the anterior part of each subventral gland and surrounded by deeply staining cytoplasm, but no cell wall observed; s_{7-8} are similar nuclei situated ventral and medial to the subventral glands. Nuclei in similar positions and of similar character are present in other nematodes, but a comparison of these nuclei will not be taken up until later.

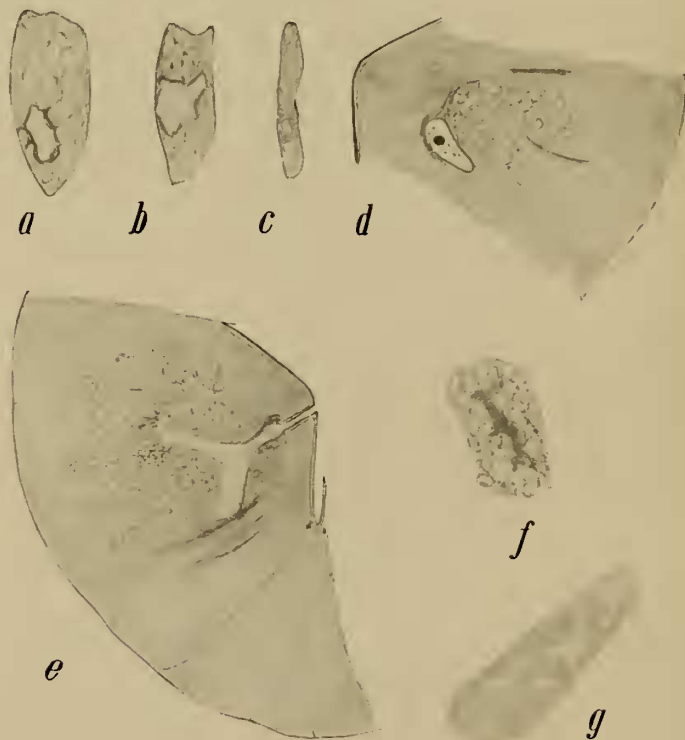


Fig. 4.—Esophageal gland mass as seen in cross section. *a*, dorsal gland near orifice; *b*, dorsal gland immediately posterior to *a*; *c*, dorsal gland at level of m_{1-1} ; *d*, subventral gland anterior to orifice; *e*, subventral gland at level of orifice; *f*, subventral gland in section immediately posterior to *e*; *g*, subventral gland in anterior part of bulbar region.

The nerve cell nuclei (n_{26-30}) of the bulbar region are, in general, larger nuclei than those of the corpus (Fig. 3); all contain a lobed nucleolus in a clear nucleoplasm having a few basophilic granules. The cell bodies are large, the cytoplasm lightly eosinophilic and sometimes vesicular (see n_{30} of Fig. 4). All of these cells appear to be commissural cells; they have 2 chief processes which come off at the same side of the cell body and then diverge. The single s nucleus (s_9) of the bulbar region appears to be similar to the nuclei of the nerve cells of the same region but no cell body has been observed.

ESOPHAGEAL GLANDS

The dorsal esophageal gland has a very short narrow duct lined with cuticle which is continuous with a protoplasmic central tubule having a thick deeply basophilic wall. This tubule becomes wider and bifurcates posterior to the orifice of the gland, each branch giving off numerous short branches which are continuous with the coarsely reticulate, deeply basophilic cytoplasm of the gland (Fig. 4a-b). In the anterior part of the precorpus the dorsal gland is rather wide and circumscribed, and occupies a central position in the dorsal sector. In the remainder of the corpus the dorsal gland is narrow (Fig. 4c) and the gland mass finely reticular to alveolate; it becomes a narrow strand in the region of the isthmus, and again larger in the anterior part of the bulbar region. Near the level of its nucleus, the dorsal gland becomes multilobed and occupies a large part of the dorsal sector; in this region the cytoplasm is dense and contains a few alveoli.

The subventral glands extend some distance anterior to their orifices; in this region the cytoplasm is very finely reticulate (Fig. 4d). Near the level of their orifices the subventral glands become multilobed but the finely reticular structure remains. Each gland has an extremely short duct lined with cuticle, and continuous with this duct is a thick-walled protoplasmic tube which is immediately multibranching, the branches continuous with the reticulum. Posterior to this region the gland mass, like the dorsal gland, becomes smaller until it is finally reduced to a delicate strand of protoplasm in the isthmian region. The subventral glands become enlarged in the posterior part of the prevalvar region, become lobed in the region of their nuclei, and then continue to be large and lobed nearly to the base of the esophagus. The protoplasm is dense throughout this region except in the part adjacent to the lumen. In general, the mass of the subventral glands is less basophilic than that of the dorsal, and sometimes appears to be very slightly eosinophilic.

ZOOLOGY.—*Development and morphology of the cestode, Hymenolepis cantaniana, in coleopteran and avian hosts.*¹ M. F. JONES and J. E. ALICATA, Bureau of Animal Industry. (Communicated by ELOISE B. CRAM).

Previous to the preliminary note by Alicata and Jones² in 1933, the life history of the poultry cestode, *Hymenolepis cantaniana*, was unknown. There was reported at that time the finding, in the dung beetle *Ataenius cognatus*, of proliferating larvae which consisted of a mycelium-like structure, numerous buds, and partially or completely de-

¹ Received March 12, 1935.

² ALICATA, J. E., and JONES, M. F. *The dung beetle, Ataenius cognatus, as the intermediate host of Hymenolepis cantaniana.* Jour. Parasitol. 20: 244. 1933.